~~Description~~

Method for controlling a switching system

TECHNICAL FIELD OF THE INVENTION

~~The invention relates to a method for controlling a switching system which has a central~~ control unit and a number of peripheral terminal devices, wherein

- a job message is sent from one of the terminal devices ~~to~~ the control unit,
- switching control actions are performed ~~by~~ the control unit in dependence upon the job message, and
- in case of successful performance of those actions, a corresponding performance ~~message is sent from the control unit to the terminal device.~~

BACKGROUND OF THE INVENTION

~~In modern switching systems of telecommunication networks such as, for example, the~~ EWSX system of the applicant, there are connected to the central control unit ~~--the so-~~called MP (Main Processor)-- a plurality of peripheral modules on ~~which~~ there is also a processor. The peripheral modules are, for example, ~~terminal~~ devices such as so-called SLMs (Subscriber Line Modules) or, ~~in the~~ case of the EWSX system, so-called LICs (Line Interface Circuits), ~~and~~ serve to link terminal line units and other switching systems. ~~The~~ central control unit coordinates the operation of the terminal devices and manages the services occurring at the exchange.

Various methods and, in particular, protocols can be used for the exchange between the two processor platforms of the central control unit, on the one hand, and the terminal device, on the other. Since reliable exchange of those message is of course very important, the methods and protocols for the exchange of messages must ensure that no messages are lost and that the data records held at the involved processor platforms always agree with one another.

It should be pointed out that the central control unit can communicate with a plurality of terminal devices simultaneously, each message exchange being, in principle, independent. It should be further noted that, in principle, a terminal device is allowed to send a new

job message to the control unit even before all the preceding jobs have been finished by the control unit and concluded with a performance message. Such a job message which was sent from a terminal device to the control unit and is now being processed by the control unit, but for which no performance message has been issued yet, is designated here as being "open".

INSA4 lag4 In commonly used protocols for message exchange within a switching system, there is a known capability for a job dispatched by a terminal device to be canceled at the central control unit as long as the processing of the job is not yet completely finished. In the event of an error in the job processing, the old job is first called back and then started anew with a new job message. But such a callback of a job has the consequence that all actions already initiated, including those that were already brought to a successful intermediate status, have to be canceled again, which involves a considerable avoidable effort.

INSA5 lag5 The problem addressed by the invention is therefore to modify the performance of the INSA6 lag6 message exchange and its processing in such a manner that requested jobs and actions are completely executed, it no longer being necessary to cancel activities already conducted in the event of a termination of the job, e.g., in the event of an error.

INSA7 lag7 Starting from a method for controlling a switching system of the initially described type, this problem is solved according to the invention in that, at the terminal device(s), any open job message for which the associated performance message has not yet arrived after expiration of a specified wait time from the time of its sending is resent to the control unit and, at the control unit, switching control actions based on an arrived job message are skipped if they were already processed by means of earlier job messages and/or are to be omitted on the basis of a preset rule.

INSA8 lag8 The posed problem is solved in a simple manner by this solution, and a clear reduction of effort at the central control unit can be achieved. At the terminal device, an examination as to whether messages are void owing to subsequent job messages can be eliminated, whereby the effort to realize the control of the terminal devices is simplified.

In a preferred embodiment of the invention, when the job message is resent by the terminal device, the wait time for the arrival of the associated performance message starts to run again. The sending of the job message is thereby repeated in a favorable manner until the associated performance message arrives.

In a variant embodiment, at the terminal device the wait time is determined individually according to a preset rule as a function of the type of job message. In a time-saving manner, the repetition cycle of the job message can thereby be adjusted to the expected effort at the central control unit.

It is additionally favorable if at the terminal device the sending of additional job messages is delayed upon exhaustion of a send window which describes a preset maximum number of job messages not answered by a performance message. However, the repeated sending of the open job messages can continue to proceed. In this manner, an overflowing of the control unit with open jobs is avoided.

An especially simple and suitable choice is for the send window to comprise two job messages.

In order that messages coming later at the terminal device not lead to any losses, it is favorable if additional job messages whose sending is delayed owing to the exhaustion of the send window are buffered in a queue.

For a reduction of the message occurrence it is further advantageous if at the control unit an acknowledgement message to the terminal device is omitted in the event of an interruption of the performed actions owing to an error.

The invention will be explained in more detail hereinbelow by means of a nonrestrictive exemplary embodiment which relates to the protection switching of multiplexed sections ("multiplex section protection switching") in an EWSX system, referring to the appended Figures in which:

~~Fig. 1 shows signaling procedures between a terminal unit and a central control unit of the EWSX system, which proceed in the trouble-free case according to the prior art, and~~

~~Fig. 2 shows a signaling procedure according to the invention.~~

~~In the case of multiplex section protection switching, additional intrinsically redundant~~ elements ("protecting" elements) are provided and kept in a standby mode for the hardware elements and data objects ("protected elements) used in a communication service. In the event of a disturbance of the "protected" elements, the "protecting" elements can take over the task of the failed elements and thus maintain a substantially trouble-free operation. More-detailed information about protection switching follows from Recommendation ITU-T G.774.03 of the International Telecommunications Union (ITU). As regards the protection switching, a message exchange is initiated between a terminal device and the central control unit. Here the message exchange is begun in principle by the terminal device, since the terminal device is responsible for detecting changes on the line, performs a protection switching if necessary --e.g., in case of a disturbance--, and then exchanges messages about those measures with the central control unit. At the control unit, corresponding actions relating to the control and management of the switching system are executed on the basis of those messages, e.g., an updating of the protection status, a change or updating of the affected data objects, the informing of other programs of the control unit about any changes relating to the availability of the affected service, and, especially, the sending of message acknowledgements to the terminal device.

Fig. 1 shows a schematic illustration of a signaling procedure between a terminal device AE and the central control unit MP. The terminal device AE sends a message mdg to the central control unit MP, which, depending on the message, executes the required actions ak1, ak2, ..., akn and, after processing the requested actions, sends to the terminal device a performance message dfn, designated hereinbelow for short as an acknowledgement. Since in this case the acknowledgement is made in a regular manner, this signaling procedure coincides with the signaling procedure known from the prior art.

INSA12 Aa12 Suppose, for example, that from the terminal device AE there is sent to the central control unit MP a message mdg which relates to a change of the protection status of the multiplexed section, namely, for example, a switchover between protected and protecting sections owing to a loss of service. At the control unit MP, the protection statuses of the associated data objects are now changed through the actions ak1 and ak2 and, if necessary, the associated data structures are reconfigured. After waiting for a time interval t1, the control unit performs action akn in which it sends out a notice message (not shown in Fig. 1) to other processes of the EWSX system in order to notify the other applications about the nonavailability of the associated service. After that has been performed successfully, the corresponding acknowledgement dfn is issued.

INSA13 Aa13 No form of examination is made at the terminal device as to whether or not certain messages are still meaningful. According to the invention, all open messages, i.e., all messages for which no acknowledgement was sent yet, are each sent to the control unit after expiration of its wait period and, in a favorable manner, is repeated until the corresponding acknowledgement has arrived. At the control unit, the requested actions are performed in a known manner on the basis of a message that arrived from the terminal device, until the processing is completed or an error occurs. In the event of any irregularity, the processing is terminated; the central control unit then waits for the next message from the terminal device. In this manner, error-correction measures at the control unit can be dispensed with.

INSA14 Aa14 If, for example, as is shown in Fig. 2, an error occurs in action ak2 --the reason for the error being irrelevant for the invention at this point--, then the control unit MP terminates further processing and no further activities (relating to that message from the terminal device) occur; the acknowledgement to the terminal device is omitted. After a set time tw, the message mdg is repeated by the terminal device AE. The action ak1 was already performed; action ak2 is restarted. If now the other steps t1,akn proceed successfully, an acknowledgement dfn is made to the terminal device.

INSA15 Aa15 Cont The maximum allowed number of messages that are sent out from the terminal device and not yet acknowledged by the control unit is advantageously restricted to a "send window". However, before the sending of another message that extends beyond the

A15 Cancel

allowed number, one of the messages being processed must be acknowledged. The terminal device repeats the still unanswered messages --without any time limitation-- until they are acknowledged. Messages from the terminal device extending beyond the send window are suitably placed in a queue of the terminal device. When an acknowledgement arrives for an open message, that message is removed from the send window; the next message is taken from the queue, sent to the control unit and included in the send window until the arrival of its acknowledgement. In this manner, no messages can be lost.

If simultaneous processing of a plurality of jobs is allowable, job messages can be sent while other jobs are still open, taking into consideration the preset send window. In Fig. 1 that would mean that, between the job message mdg and its acknowledgement dfn, one or --if allowable-- several other job messages relating to other processes are sent from the terminal unit AE. These other messages are not to be confused with repeated messages such as in Fig. 2.

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Since the messages from the terminal device can lead to, among other things, both the activation and deactivation of the associated service and since, moreover, a time evaluation of those messages occurs at the control unit, the send window is favorably established as being two messages. Hence up to two messages from the terminal device can be undergoing processing at the control unit. It is thereby guaranteed that, for example, at the control unit during the course of a time interval whose course was started, e.g., to await the arrival of a release message by means of a message from the terminal device and which is not acknowledged until completion or termination, the release message can be sent from the terminal device and leads correctly to an termination of the time interval.

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This is illustrated by way of example in Fig. 1a. As in Fig. 1, a message mdg relating to a switchover between protected and protecting sections is sent from the terminal device AE, and the corresponding actions ak1 and ak2 are initiated at the control unit MP. However, service is restored at the terminal device AE during the time interval t1. Accordingly, a second message wdm occurs, which revokes the loss of service. Namely, the time interval is set so as to allow a possible revocation. At the central control unit

MP, both the first message dfn[1] and also its revocation wdm are now each acknowledged with an acknowledgement dfn, df2, respectively. However, if the processing was interrupted as in Fig. 2, both acknowledgements dfn, df2 are omitted. In this case, both messages mdg and wdm are repeated by the terminal unit until the corresponding jobs are correctly executed and acknowledged.

In some circumstances the processing of a message can take quite a long time -- up to several seconds or, in special cases, about a minute. During that time, various error branches can be run through at the control unit, e.g., on the basis of a deficiency of resources, missing or incorrect acknowledgements, etc. The actions that are executed until the termination owing to an error branch are not canceled. Since also no acknowledgement is sent from the control unit, the original message from the terminal device is repeated. At the control unit, already executed actions are skipped or updated; the actions still outstanding are now performed. Which of the actions have already been processed and thus can be omitted is determined by means of a predefined rule. That rule can depend on the particular application and can make allowance for various attributes such as, for example, the protection status (protecting or protected), the operating status (free or blocked) or a processing time. Not until all actions have been completely processed does the control unit send the corresponding acknowledgement to the terminal device.

No evaluation is made at the terminal device as to whether, e.g., in the case of a message status, certain messages have become "obsolete" in the meantime and can thus be discarded. Rather, all message events are buffered and each of them is sent to the control unit after expiration of the wait time, if the associated acknowledgement has not yet arrived.

For reasons of simplicity, the value selected for the wait time tw is a uniform value which is dimensioned according to the expected time for error-free execution of the longest job. In a variant embodiment, the wait time tw can be determined individually at the terminal

[1] *Tr. note: This appears to be incorrect. The first message is mdg, not dfn, as is made clear again in the last sentence of this paragraph.*

device in accordance with a preset rule as a function of the type of job message, thereby enabling the repetition cycle of the job message to be adjusted in a time-saving manner to the expected effort at the central control unit.